DOCUMENT RESUME

ED 229 236 SE 041 436

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TITLE Extension of TVCAI Project to Include Demonstration of Intelligent Videodisc System. Hardware, Software, and Courseware Implementation Component. Final Report.
INSTITUTION Utah Univ., Salt Lake City. Dept. of Computer Science.
SPONS AGENCY National Science Foundation, Washington, D.C.
REPORT NO SED-82022
PUB DATE 82
GRANT NSF-SED-79-00788
NOTE 34p.
PUB TYPE Reports - Research/Technical (143)

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS *College Science; Computer Assisted Instruction; *Computer Oriented Programs; *Computer Programs; Electronics; Higher Education; *Material Development; Microcomputers; Physics; Science Education; *Videodisc Recordings
IDENTIFIERS Science Education Research

ABSTRACT

This project, stemming from work started under the National Science Foundation grant "Development of a Television Computer Assisted Instruction (TVCAI) System" SER-7806412, called for the transfer to videodisc of some of the videotape materials developed under the grant. Three efforts were included in the proposal: design and development of hardware and software for the intelligent videodisc system, design and selection of courseware for the system, and courseware evaluation. This report contains a summary of the work completed in support of intelligent videodisc systems. Hardware and software developed, the videodisc produced (which contains physics materials), and the demonstrations given of the intelligent videodisc system are discussed. In addition, the report contains a description of current work both in extending the usefulness of the intelligent videodisc system and in support of other users. General remarks concerning the appropriate use of intelligent video systems in education are also included. Timing differences, Video-computer Courseware Implementation System (VCIS) video documentation, and lists of demonstrations/workshops and publications are included in appendices. (JN)

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F I N A L R E P O R T

Extension of TVCAI Project to Include Demonstration of Intelligent Videodisc System

NSF Grant SED79-00788

Hardware, Software, and Coursewa_e Implementation Component

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INTRODUCTION

The proposal "Extension of TVCAI Project to Include Demonstration of Intelligent Videodisc System" stemmed from the work started under the NSF CAUSE grant "Development of a Television Computer Assisted Instruction (TVCAI) System" SER-7806412. The CAUSE grant called for the development of computer aided instruction material augmented by videotape materials. Professor John DeFord was the Principal Investigator for the CAUSE grant. The intelligent videodisc proposal called for the transfer to videodisc of some of the videotape materials developed under the CAUSE grant. Specifically the videodisc proposal stated:

> "We are in a position to apply materials which have either been developed or are being developed under the CAUSE project to the videodisc project <u>without</u> modification." (p.3)
>
> "We will use videotapes developed under our CAUSE grant and have them transferred to videodisc." (p.7)

Three distinct efforts were described in the videodisc proposal: (1) the design and development of the hardware and software for the intelligent videodisc system (pp. 3-13); (2) the design and selection of courseware for the system (pp. 13-16); and (3) the evaluation of the courseware (pp. 16-22). Richard Brandt and Barbara Knapp, the authors of this report, were responsible for item (1) and for the implementation of the courseware.

This report contains a summary of our work in support of intelligent videodisc systems. We discuss the hardware and software developed, the videodisc produced, and the demonstrations given of the intelligent videodisc system. In addition, the report contains a description of our current work both in extending the usefulness of the intelligent videodisc system and in support of other users. Some general remarks are included concerning the appropriate use of intelligent video systems in education.

1. HARDWARE DEVELOPMENTS. The proposal outlined three levels of support for the videodisc. The actual work was affected by developments in commercial hardware and differed somewhat from that contemplated in the proposal.

1.1 First Level. This level called for the use of videodisc players instead of videotape players as a delivery medium for the video material produced under the CAUSE grant. The proposal called for the use of the Utah State University MCA Discovision, Inc. prototype videodisc player to replace the Sony VP-2000 tape player. By the time the proposal was awarded, the production model videodisc player, the PR-7820 player, was available from Discovision Associates (DVA) so our first videodisc interface was developed for this player. This interface is described in detail in the first interim report.

The student unit developed differs somewhat from the unit described in the proposal. The use of a standard color TV for presentation of material in the intelligent videodisc system was found to be undesirable because the electromagnetic noise generated by the computer lowered the picture quality. The noise problem was eliminated by substituting the Panasonic CT-110M metal shielded color monitor for the 9 inch Sony television in the student units. In addition, to permit students to easily glance back and forth between the color TV monitor and the black and white Terak monitor, the color monitor was mounted on a base so that it was at the same height as the Terak monitor.

A Panasonic 8200 1/2 inch videotape recorder was purchased since its capabilities were closer to those of a videodisc player. With this player you can center freeze frame images on the TV monitor and single step forward. In regular play, it provides a video picture almost as good as one from a videodisc player. A computer interface was developed for this player.

During the grant period, Discovision introduced two additional models of the PR-7820 player: the PR-7820-2 and the PR-7820-3. The PR-7820-2 has a two way parallel interface and the PR-7820-3 has a combined serial and parallel interface. Internally, the PR-7820-2 contains a number of modifications to the microprocessor board and the video display board. Since we were notified by engineers at Discovision (now Pioneer) that the PR-7820-2 was going to be discontinued, we did not attempt to design an interface for it even though it had a much shorter search time than the original PR-7820, now called the PR-7820-1. The PR-7820-3 player is similar to the PR-7820-1; the only difference is in the ROM chips on the microprocessor board. The new ROM chips, which support a larger number of video commands and a short search time, altered the timing requirements slightly. This required a change in the interface board which is described in the following paragraph.

On the original PR-7820-1 player, commands are entered between the Ready pulses (see Appendix A, Diagram 1). On the PR-7820-3 player, commands are entered during the Ready pulse (see Appendix A, Diagram 2). The change to the interface board for the PR-7820-1 is minimal. The Enter line from NOR gate 3C, pin 13, is cut and a jumper from the Data Enable line, NOR gate 4B, pin 1, to the Enter line is installed. With this change commands are entered during the Ready pulse.

Although a few of the commands to the PR-7820-3 player are slightly different from PR-7820-1 commands, it was possible to take care of these differences by modifying the software. The changes are described in Section 2, Software Developments.

The performance of the PR-7820-3 player is better than the PR-7820-1 particularly for short searches. The time for a short search (a short search is where the change in the frame number is less than about 500) is a fraction of a second.

1.2 Second Level. This level called for the storage of digital data on both videotape and videodisc permitting the elimination of the floppy or hard disk drive. The plan was to store 320 bits/frame on audio track 2 on the videodisc and on audio track 1 on the videotape. At the time the proposal was written this seemed like a useful step. The drawback to this approach, unrecognized when the proposal was written, is that digital data stored on videotape is not easy to edit and digital data stored on videodisc is impossible to edit. When we were ready to implement the second level we concluded that storage of digital data on videotape or videodisc was unwise. Consequently, we requested and received permission from Dr. Dorothy Deringer of the NSF to exclude the second level.

1.3 Third level. The third level called for the transition from a two screen intelligent video system to a single screen system supporting the superposition of computer-generated material on a video signal. Since no commercial units for this particular application were available at the time the proposal was written, the exact form of this superposition was not specified in the proposal. After the contract was awarded, R. Brandt met with Terak managers and engineers and convinced them of the desirability of manufacturing such a unit. Terak has introduced their video overlay system, we will receive a demonstration version in the near future. Terak was one of two companies in the country which could demonstrate a high quality video overlay system in the summer of 1982.

A high quality video overlay system has these characteristics: the computer-generated material is synchronized with the video signal from the videodisc player; the display device is a high resolution red-green-blue (RGB) monitor; and the video signal from the videodisc player is converted into separate red, green, and blue signals.

The computer-generated material must be synchronized with the video signal from the videodisc player since the videodisc player is a mechanical device and consequently has speed variations. If the computer-generated material was not locked to the signal from the videodisc player, either the graphics image or the video image would wander or jiggle on the screen.

High resolution, high quality RGB monitors are necessary if computer-generated text is going to be easily read by students. The two critical factors are the fineness of the shadow mask and the quality of convergence. We have found that even high resolution RGB monitors are difficult to read for long time periods if the convergence is slightly off.

The signal from the videodisc is a standard NTSC signal which cannot be sent directly to an RGB monitor. The NTSC signal must first be converted to red, green, and blue signals. The cost of the required high quality filter is still significant. The Lenco comb filter is about $2200; the Terak filter units and overlay hardware is about $2000.

Unfortunately, the current cost of a high quality video overlay system is still too expensive for most educational uses. The educational cost for the Terak color microcomputer system is more than $12,000 and the cost for the AED terminal which supports color overlay is about $13,000.

1.4 New Developments. In the last few months there have been several developments which we believe will encourage wider use of intelligent video systems in education. These developments are described below.

First, we have discontinued internal production of interfaces and have transferred the production and development of new videotape and videodisc interfaces to a local company, Terabit Inc. They have designed a two-card controller that handles videodisc or videotape players. The first card contains a Z-80 microprocessor and an RS-232 interface for communication to the host computer. The second card which is used to control the videodisc or videotape player is designed to match the particular player. The interfaces will feature full two-way communication.

We plan to test the first units in January, 1983. A useful feature of these new units is that they will support identical low-level commands for videodisc and videotape. Consequently, the same software can handle both videodisc and videotape.

Second, Gary Fitton has developed for Dr. Isaac Bejar of Education Testing Service a graphics overlay generator which permits the overlay of computer-generated characters and graphics from a Terak 8510a on an Amdec color television monitor displaying videodisc information. This was done for an

NSF-NIE grant in secondary school mathematics. Although the primary emphasis of the work was the superposition of graphics, 80 characters of text per line is reportably legible. This interface is significant since it appears to demonstrate that a readable overlay can be achieved at a relatively low cost. Information about this work can be obtained from Dr. Bejar at Educational Testing Service, Princeton, New Jersey 08541.

Finally, we have initiated talks with a leading television maker that has entered the computer market with a well-designed system priced at slightly over $4,000 which includes a good RGB monitor. We hope to persuade them to include the overlay capability. The company has already introduced a digital television with an RGB monitor and the company clearly has the technical competence to include overlay at a modest cost.

2. SOFTWARE DEVELOPMENTS. Although the proposal outlined three levels of support for the videodisc, only the first and third levels of hardware support were implemented for reasons discussed in Section 1.2. There will be software support for these two levels only. The software support of videotape and videodisc is evolving as we learn from our experience and from the needs of users of the Video-computer Courseware Implementation System (VCIS) software.

2.1 First Level. The first level called for the use of videodisc players as well as videotape players as the delivery medium for video material produced under the CAUSE grant.

Three VCIS programs support the use of video in lessons. The author uses the SELECT program to select and preview sections of video material on tape or disc. The author or the lesson implementor uses the BUILDER program to specify the video commands. The lesson is run by the program INTERP which interprets the video commands. The VCIS documentation on the SELECT program and the BUILDER video commands is included in Appendix B.

Videotape is useful for formative evaluation even though the performance of videodisc is superior to videotape for several reasons. Videotape is a serial device while the videodisc is a random access device. Search times are roughly 30 times longer on videotape introducing normally unacceptable delays in lessons. However, since the use of videotape is important in formative evaluation, we have written our software so that the control of videotape and videodisc appear identical. On the $1000 Pansonic 8200 videotape machines, it is impossible to single step backwards and to play in slow motion backwards. On more expensive tape players, such as the $4,000 Panasonic 1/2 inch editing machines, these commands work. In addition, on a videotape, audio track 2 may not be used for a second audio channel since it must contain the SMPTE time code.

We will be phasing out support of the older tape players such as the VP-2000 since they require a significant internal modification before they will work in an intelligent video system. Furthermore, these tape players support only a few commands. Consequently, the next distribution of VCIS will provide all the available commands for the new players. In the VCIS BUILDER program which establishes the lesson structure, all commands are videodisc commands. In the VCIS INTERP program which runs the lessons, only some of these commands are implemented if the video device is a tape player.

Our software no longer uses the autostop command on the videodisc player. The autostop command was convenient because it permitted a specified video segment to be played. However, it is impossible to interrupt an autostop command once it has started. Consequently, we now simulate the autostop command in software, reading the frame number from the videodisc on every other clock interrupt.

2.2 Third Level. Software support of the third level hardware, although well underway, is incomplete. Development of the software has taken longer than we anticipated for the reasons outlined below.

First, we could not use the existing graphics driver to send commands to the color Terak system, the 8600. The interface software to the 8600 takes 1000 words of memory. We do not have this space available when we run the lesson interpreter program, INTERP, so we decided to write a graphics driver which would be resident in the 8600. To do this it is necessary to (1) learn how to move programs to the 8600 and execute them, (2) develop an 8086 assembler, and (3) write the driver in 8086 assembly code. We have developed an 8086 assembler that runs on the Terak and we have learned how to move programs to the 8600 and execute them. We have not written the driver in 8086 assembly code as yet for reasons described below.

Second, we decided that the existing graphics driver and graphics editor needed to be entirely rewritten. The new graphics driver has been written in PDP-11 assembly code and is based on five primitive operations: polyline, polydot, polymarker, polycurve, and polyfill. The new driver supports all the features of the Graphics Kernel Standard (GKS) primitives, except text display. We selected GKS instead of the Siggraph Core Proposed Standard as a model since GKS is oriented more toward raster scan devices and produces more transportable files. We designed the driver so that graphics data files could be used on machines with widely different aspect ratios. We are deferring the implementation of the new driver in 8086 and 68000 assembly code until we complete the testing of the PDP-11 assembly code driver.

We are presently working on a new graphics editor which uses the new driver. With this editor, it is possible to stretch, rotate, and zoom objects. The target date for the completion of the editor is February 1983. We will be testing the graphics editor on the black and white units before moving it to the color machines. We are presently defining the structure of the graphics data files which will be transportable and always editable.

3. VIDEODISC PRODUCTION. Our proposal specified the production of nine videodisc masters. However, based on the unrealistically low costs of pressing given us by DVA, we budgeted only enough money for three videodisc masters. We produced two videodisc masters for a two-sided disc which is described in Section 3.1.

3.1 Videodisc Material. We produced one two-sided videodisc which contains a collection of materials related to lessons which were developed under the CAUSE grant. Professors Bergeson and Ohlsen, and graduate student Ken Wood chose to use an Education Development Center, Inc. 23 minute film, An Introduction to the General Purpose Oscilloscope. This was to be used with the CAUSE TVCAI lessons for the junior level electronics course. For the introductory physics course, Professor Kadesch developed a 40 minute audio section on basic units, a 10 minute audio and video section on projectile motion, and selected 9 minutes of film clipped from material provided by Caltech's Jet Propulsion Laboratory. For a junior level modern physics course, graduate students Tom Buzak and Gregg Hoffmann developed a 15-minute video and audio section introducing quantum mechanics.

Professor Kadesch's material was developed specifically for the intelligent videodisc. His material merged quite well with the computer-generated parts. However, the oscilloscope videodisc material was developed for videotape or film use, and did not take advantage of the videodisc's capabilities, such as freeze frame and slow motion. This has made the development of the lessons associated with the material difficult. For example, we have found that the oscilloscope lesson would be much more useful if there were still frames of a few waveforms and of the fronts of the oscilloscopes the students use. We have had to use computer-generated graphics where frames on the videodisc would have been more effective. From this experience, we recommend that the computer-based material and the corresponding video material be designed simultaneously.

3.2 Cost of Videodisc Mastering and Pressing. The actual cost of mastering our videodisc was much higher than the estimated cost of $800 per side. The actual costs for our videodisc are described in this section.

In October 1980, we sent DVA approximately 60-minutes of audiovisual material on 1-inch C format tape which they transferred to 2-inch quad format. Transferring our tape and adding frame numbers cost $550 per side. Mastering the videodisc cost $1500 per side. This was the lowest possible rate since our disc was a straight linear play disc; that is, no program control was contained on the disk. In addition, we paid $10 each for 50 copies of the disc, which was the minimum order at the time. Incidental costs for a check tape and postage came to about $100, so the total cost for the two-sided disc and the copies was about $4700.

4. SYSTEM DEMONSTRATION. Partial lessons were developed around four videodiscs for demonstration purposes. We have given over sixteen presentations and/or workshops on the role of videodisc in education in the past three years. Appendix C contains a summary of these. Appendix D contains a list of our publications related to videodisc use.

The first demonstration lesson was designed by B. Knapp and R. Kadesch and used the Nebraska and University of Mid-America disc on metrics. The lesson featured an introduction to metric units and practice in conversion between metric units. Students were given some practice using metric units in the lesson when they were requested to enter the dimensions (in centimeters) of the monitor and videodisc player. The lesson was demonstrated at the January, 1980 APS-AAPT meeting in Chicago.

The second demonstration lesson was designed by B. Knapp and Ned Davison of the University of Utah Languages Department and used the Nebraska disc on the pronunciation of the letters A and D in Spanish. This demonstration lesson used features of the videodisc not used by the group that designed the videodisc. For example, if the student selected the incorrect pronunciation of the word agua, not only was the correct pronunciation replayed, but a slow motion sequence showing a person correctly pronouncing the word was shown. This lesson has been demonstrated at the Pentagon and at the training commands of the three services.

The third and fourth demonstration lessons were designed around the 23 minute segment "An Introduction to the General Purpose Oscilloscope" on the disc developed here. Graduate student Ken Wood, now at Texas Instruments, designed the third lesson. Dr. Wood designed this as a lesson for the junior level electronics course. He completed the most critical part for that course, the section on triggering. We have used the lesson for demonstration; however, we have found that most of the audiences do not have the background to appreciate it. R. Brandt designed the fourth lesson, an introductory lesson on oscilloscopes, for the sophomore introductory physics laboratory. The lesson is based on part task training models;

the student uses an oscilloscope, a signal generator, and a voltage generator during the lesson. Although the lesson is incomplete, we have used it to demonstrate the intelligent videodisc system for training.

The fifth demonstration lesson was designed by B. Knapp and used the Tacoma Narrows disc on wave motion and forced oscillations. The first version was similar to the standalone version of the lesson designed by Bob Fuller and Dean Zollman. Our lesson created an intelligent videodisc system version. In our version, students enter their answers on the Terak keyboard; the videodisc's numeric keypad is not used. David Winch at Kalamazoo College studied the use of the standalone version and determined that students could easily enter incorrect frame numbers and get lost in the material; lesson delivery on an intelligent video system overcomes this difficulty. In response to users requests, a second version added an interrupt capability to the lesson. In this version, a student can interrupt a video segment to display a single frame, to step forwards or backwards a frame at a time, or to play forwards or backwards in slow motion. The second version is an effective demonstration of the intelligent videodisc system. We demonstrated the lesson at three conferences during the summer of 1982: ADCIS, NECC, and AAPT.

5. SUPPORT OF OTHER USERS. To encourage wider use of videodiscs in education, we have supported others who are either making videodiscs or are creating material that can be transferred to videodisc.

At the University of Indiana Medical School, Dr. Larry Wheeler has been using VCIS for the support of intelligent video. Although his initial work used videotape, his recent work has used a videodisc he mastered, and has taken advantage of the capabilities of the videodisc player. To increase the amount of video information on his disc, Dr. Wheeler consistently uses the second audio track of a video segment for the continuation of an explanation started on the first track. The PR-7820-3 player was essential for this application so that the explanation would not have a noticeable gap. It was necessary for the player to jump back around 500 frames in a fraction of a second. Since a program downloaded into the videodisc player gives the fastest search time, we wrote a special procedure for Dr. Wheeler to handle the jump back. Dr. Wheeler's audio usually corresponds to a single picture and illustrates a weakness in the present videodisc systems: audio can be included with video in only the normal play mode. Therefore, to include audio for a single picture means the picture must be duplicated on many frames. For example, to include 30 seconds of audio for a single picture, the picture must be duplicated on 900 frames, or, using Dr. Wheeler's technique, 450 frames.

At Educational Testing Service, Dr. Isaac Bejar is developing some math lessons using videodiscs on an NSF-NIE grant. We have developed for him a special procedure which allows the student to single step forward or backward in a video segment and select a video frame. The number of the frame that the student selects can then be used to determine which material is presented to the student.

Harvard Law School is using VCIS to develop law lessons. One of the lessons they are developing looks at the video frame at which a student interrupts a courtroom proceeding to determine if the student chose an appropriate time. The student interrupts the proceeding by typing any key on the keyboard. We wrote the special software to support this.

6. CURRENT WORK. A new generation of microprocessors entered the market in 1982. These new microprocessors (the Intel APX-86 series, the Motorola 68K series, and the National 16K series) will permit the use of more powerful educational programs.

Although our past work has been in Pascal, we do not believe Pascal will be the dominant programming language for these new systems because there are far too many versions of Pascal and the use of external libraries is not defined, even in the new ISO standard for Pascal. Until Ada becomes available on microcomputers, we think that "C" will be the most important programming language for major software development and that UNIX will be the dominant operating system. With the recent decision of Western Electric to make UNIX a supported operating system, the Bell version of the UNIX operating system is likely to dominate. We will no longer have to contend with a large number of versions of UNIX. In view of these developments and since "C" is becoming available on all the new microprocessors, we are moving all our software to "C", first on a VAX 11/750. Since the new videodisc and videotape controller is run through an RS-232 serial port, we feel that there will be fairly few problems in transporting the software.

7. REMARKS. As result of our experience in implementing intelligent video lessons and demonstrations, we make the following observations.

If existing film or tape is to be used, some frames should be added to take advantage of the freeze frame capability of videodiscs. If it is possible, include frames which cover related material even though the frames may not be immediately used; they may be useful for later versions of the lesson.

Include video if it improves the lesson. We have identified five areas of effective video use:

(1) where the critical visual cue cannot be accurately or cost-effectively reproduced with computer-generated graphics. For example, the visual image that a Tactical Action Officer receives when he observes an oncoming aircraft is not a line drawing but a realistic image which may be obscured by fog or clouds. Similarly, the visual image of a particular sonar signature of a submarine on an oscilloscope screen cannot be cost-effectively reproduced using computer-generated graphics.

(2) in procedural learning where a set of realistic visual cues are important. For example, a mechanic performing specific repair procedure on a car or a doctor diagnosing certain diseases needs to recognize a set of visual cues. Note that in both of these examples an additional audio cue may be important--the car mechanic listens to the car, the doctor listens to the sound of breathing.

(3) where the microcomputer cannot in a reasonable amount of time generate the needed graphics. For example, we have filmed graphics off an Evans and Sutherland Picture System using a minicomputer to perform the calculations. Obtaining the frames for a few minute segment took hours.

(4) to replace experiments which take too much time, require expensive equipment, or are dangerous. Examples of experiments that must be done in video range from dangerous chemistry experiments to the Tacoma Narrows Bridge collapse.

(5) where the combination of video and audio is important. For example, in legal training on courtroom procedure where the lawyer must learn to object at the appropriate moment.

Including video does not always improve a lesson. We have identified three areas of ineffective video use:

(1) where computer-generated graphics is both as effective and as inexpensive (or less expensive) as video. Computer-generated graphics can be easily modified at any time to improve the courseware.

(2) where textual material is being displayed. Computer-generated text is usually easier to read than video text and can be changed after the courseware is evaluated.

(3) where the students can enter a wide variety of parameters as in interactive simulations. The different options would take too much space on a videodisc.

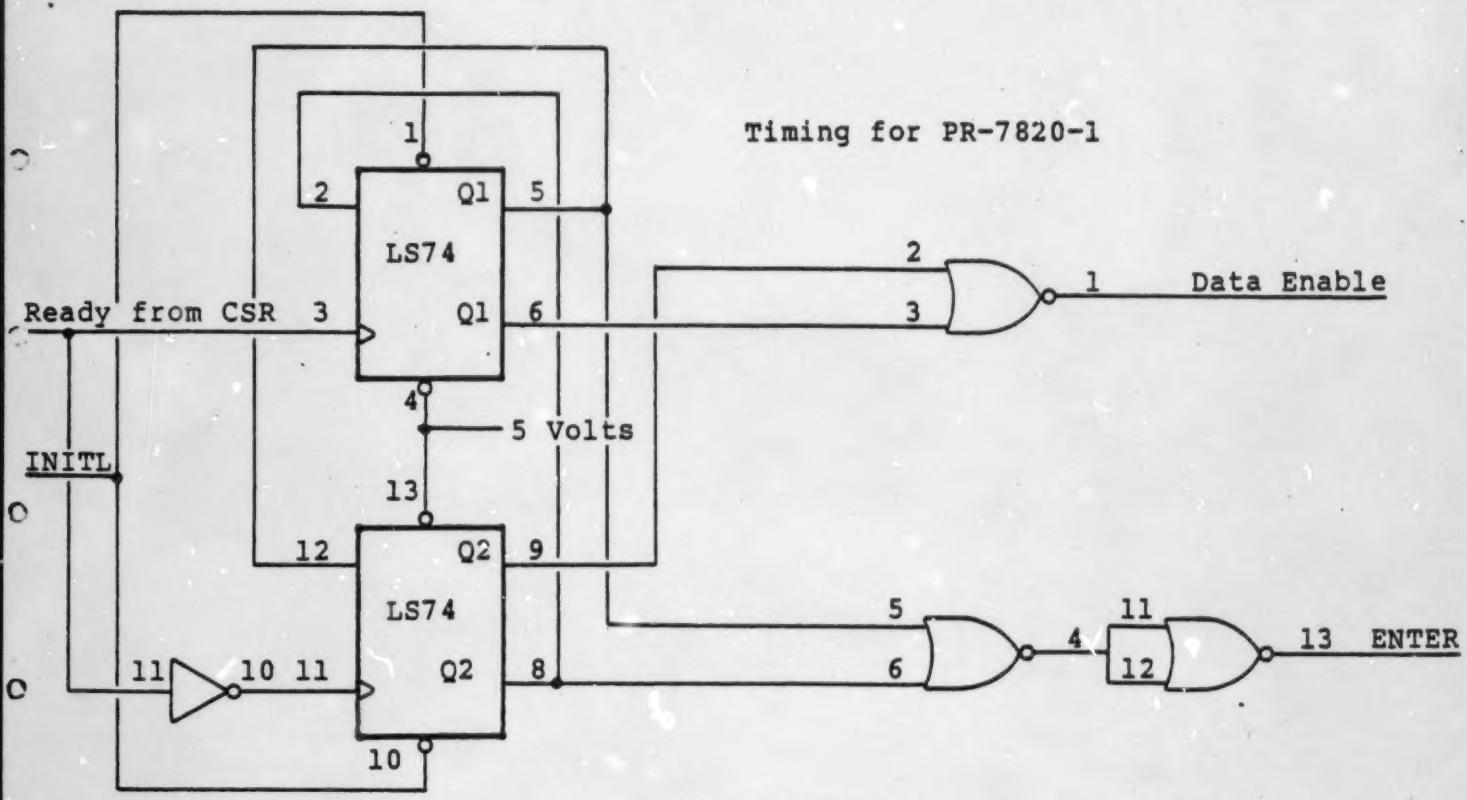
The question of whether one screen is more desirable than two has not been answered satisfactorily. It appears that in some cases a single screen is better for learning but other cases

demonstrate a two screen system is superior. For example, a two screen system is desirable if it is important to have the video material remain on the screen for reference and the computer-generated material change based on the student interaction.

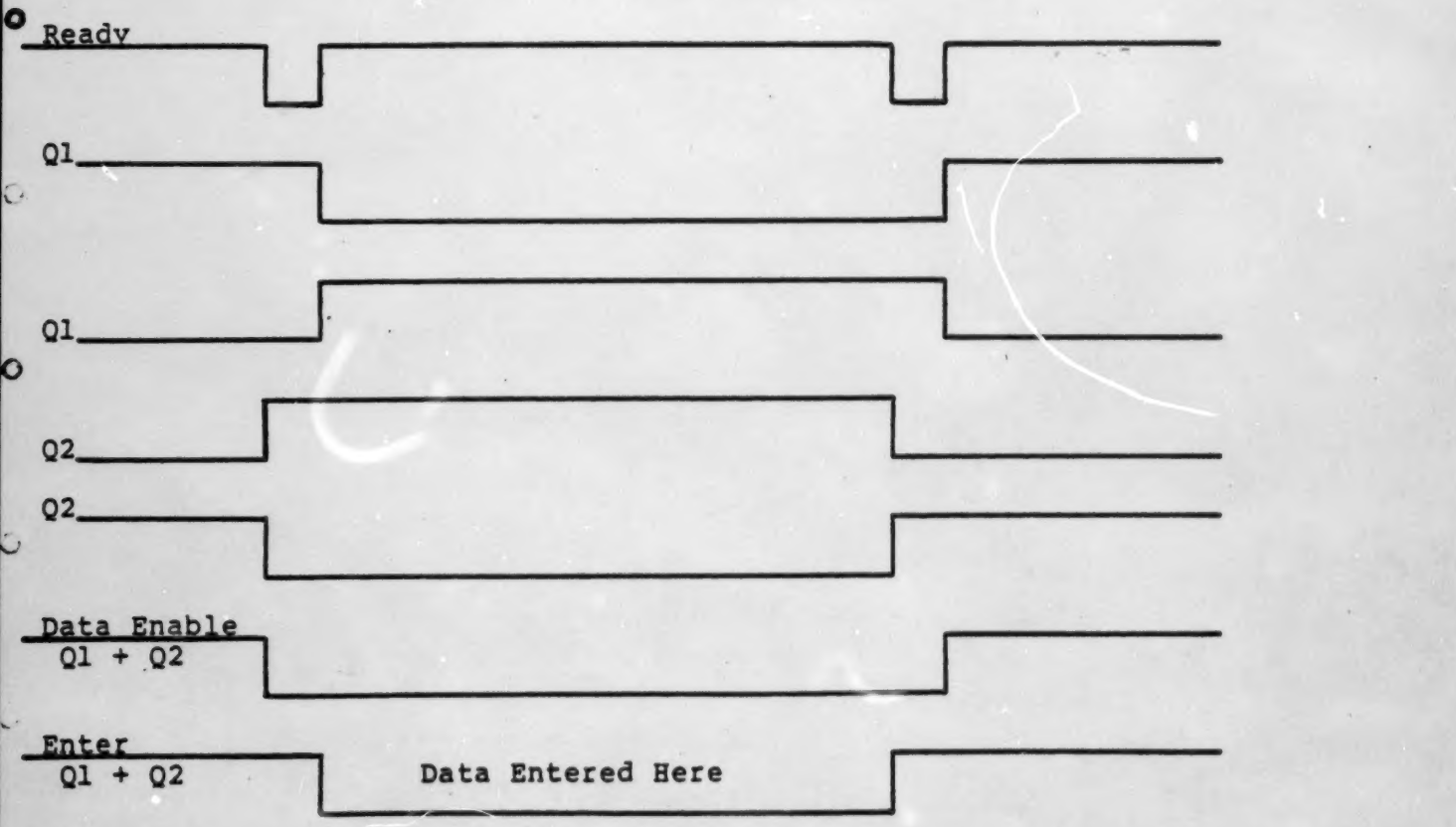
We cannot overemphasize the importance of peer review of lessons and scripts, both before and after the material is implemented, and the use of videotape as a precursor to videodisc when possible. Once the video and audio material is pressed on a videodisc it cannot be changed.

In conclusion, the future of intelligent video systems in education looks promising. Overlay onto high quality RGB systems will become standard because of decreased memory costs, the soon to be released ITT (West Germany) NTSC decoder chip, and reduced RGB monitor prices. The introduction of digital television which requires both the NTSC decoder chip and the RGB monitors will be a significant factor in lowering the prices. Intelligent CAI systems using videodiscs will become more common due to the introduction of more powerful microprocessors, decreased memory costs, and the use of Ethernet interfaces which permit the replacement of the relatively costly local disk drives.

Timing for PR-7820-1



Timing Diagram



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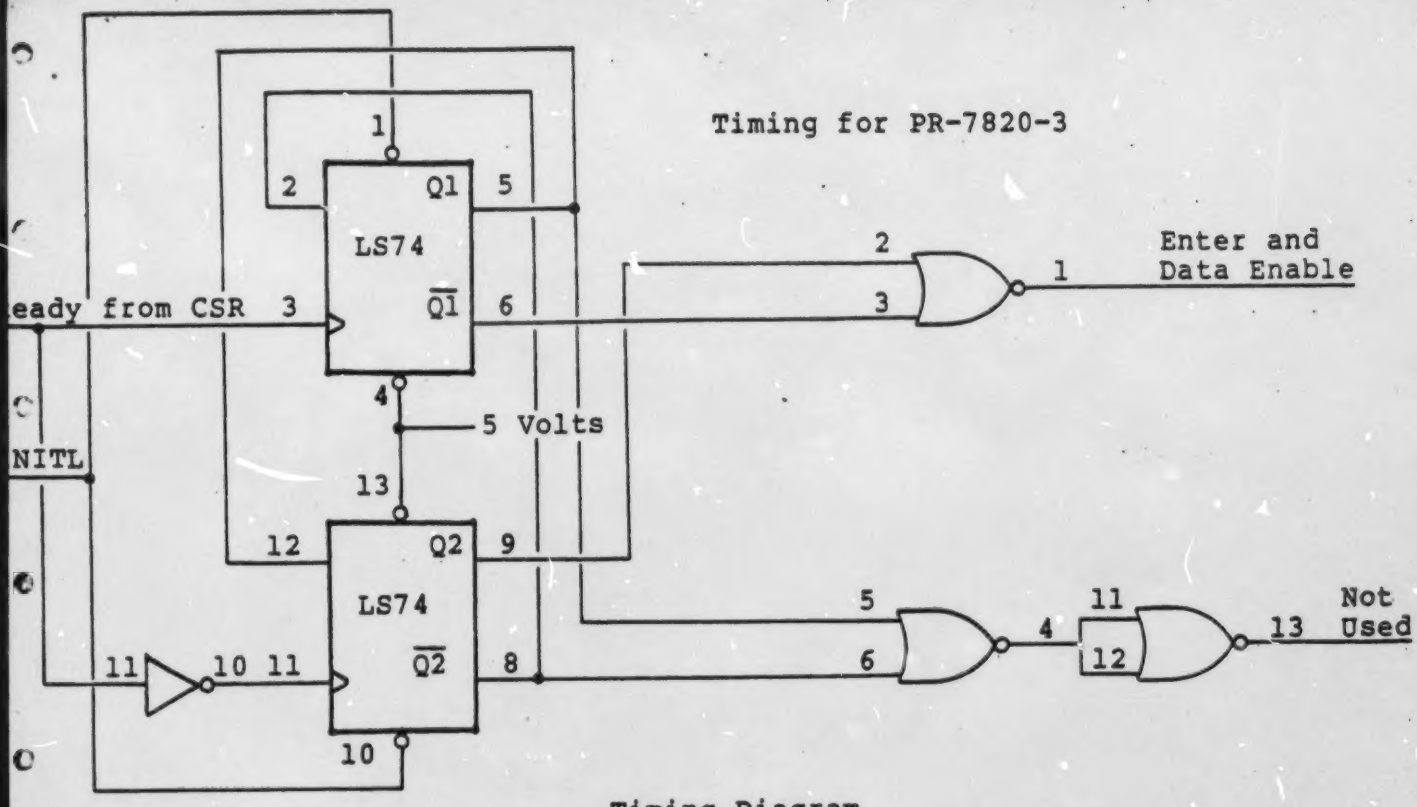
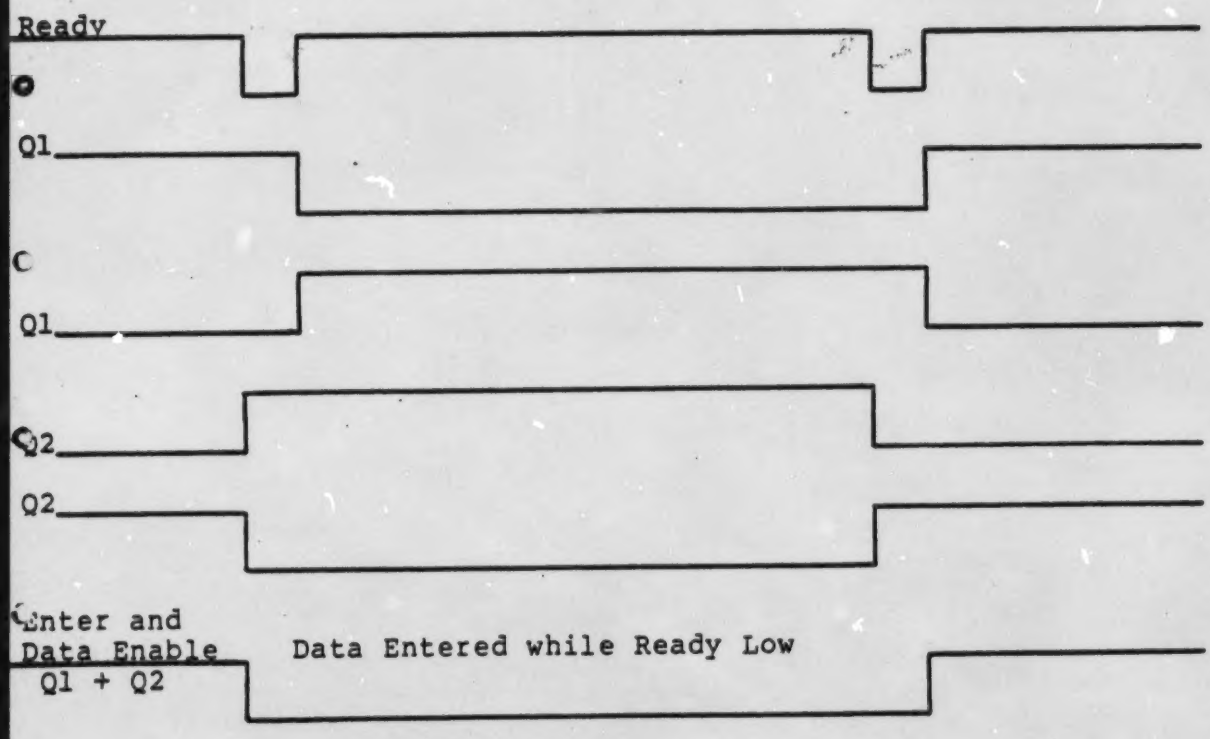


Timing Diagram



APPENDIX B

VCIS Video Documentation

10.8 SELECT

The video selection program, SELECT, is used to select the video sequences for a lesson. This program displays the video frame numbers as you view the video material on a Sony Umatic Model VP_2000 tape player or a DVA Model PR_7820 disc player. For videotape SELECT reads the SMPTE (Society of Motion Picture and Television Engineers) time code which must be recorded on audio channel 2 of the videotape; the time code is displayed as frame numbers to facilitate the modification of the lesson if the video material is transferred to videodisc. The frame numbers of the desired start and stop points can be recorded for later use in the lesson assembly program, BUILDER. The frame numbers are used by the lesson interpreter, INTERP, to control the sequencing of the video player operations.

Insert the videotape or videodisc to be viewed in the video player after making sure the Terak is connected to the player and the player is on. For the tape player, the video controller must be on also. After starting SELECT, you use the numeric keypad to choose the SELECT commands (see Section 10.8.1 for videotape and Section 10.8.4 for videodisc below). Use the Index or Enter command described below, for recording the start and stop points of the video material for the lesson. The frame numbers of these points can be recorded in a text file on the disk or on paper. When the lesson is assembled with BUILDER, choose the appropriate Display-Video command (See Chapter 7, Section 6.9) and enter the frame number or numbers at the locations in the lesson where the video sequences will be played. When the lesson is run, INTERP will control the video player using this information.

10.8.1 Initialization

SELECT checks to see which type of video player is connected to the Terak and displays the appropriate options. If no video player is connected the program terminates. If both a videotape and a videodisc player are connected, you see the following command line:

```
SELECT:  Disk  Tape
```

Type "D" to specify you would like to use SELECT with the videodisc player; type "T" for the videotape player.

SELECT does not display a promptline on the top line of the screen; instead the numeric keypad is used to specify the selected command. The screen has the keys of the numeric keypad displayed with the command they represent. Two files must be on the disk to use SELECT: the graphic to represent the numeric keypad, SELECT.GRAF, and the text to represent the options, SELECT.PAGE. If either of these files is missing an error message is displayed and the program terminates.

SELECT displays the options for the appropriate video player. Section 10.8.3 describes the videotape options; Section 10.8.5

describes the videodisc options. The next two promptlines are the same for tape and disc material.

```
Comment filename:
```

If you are going to record the start and stop points of the video material and comments in a file on the disk, enter a filename. After you have recorded the frame numbers, you can print the text file with PRINTER (Section 6).

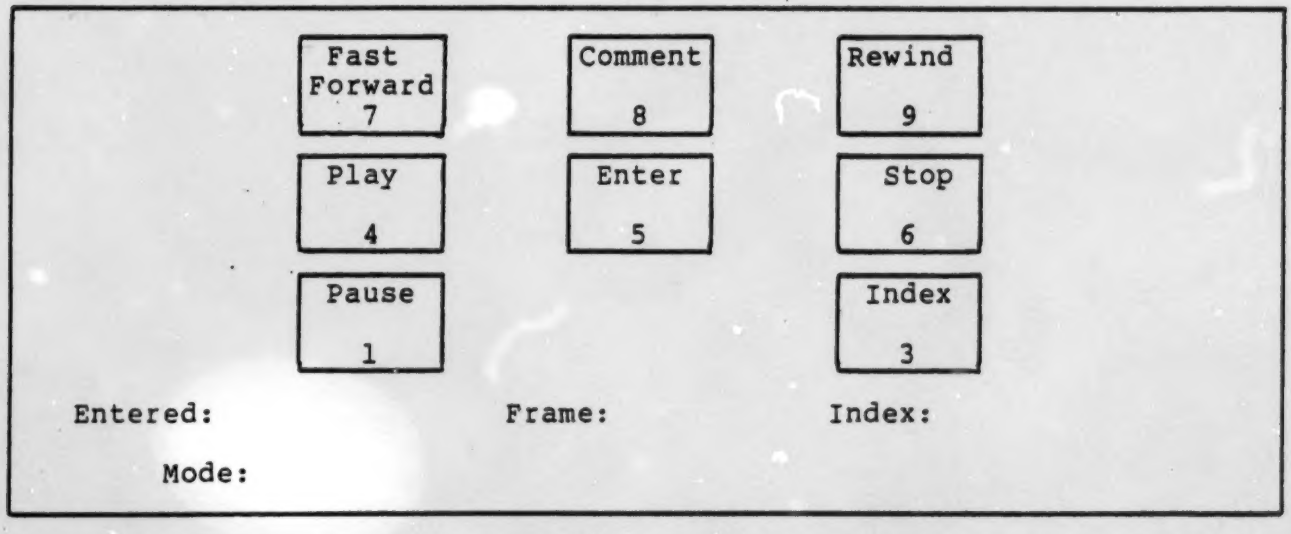
Type only <RETURN> if you will be recording the frame numbers on paper.

```
Press <LOCK> and then <RETURN>.
```

Press the shift lock key (located in the second column from the left) and then <RETURN>. The red light on the shift lock key glows when it is on. You must press the shift lock key so that the numeric keypad can be used to enter the commands and, for videodisc material, frame numbers. If the video player stops responding to commands, check that the shift lock key is still on.

10.8.2 SELECT and Videotape Material

When SELECT is run with the videotape player connected, you see:



Terak Screen Display for Videotape Material

The SELECT commands appears and then SELECT rewinds the cassette on the video player. After the tape is rewound SELECT requests the comment filename (See Section 10.8.1). A running display of the frame number of the video material is shown after the word Frame. The frame number last entered in the text file specified for

recording the frame numbers is shown after Entered:. The current frame number on the tape is displayed after Index: if you choose the Index command. The present player mode is displayed after Mode:.

10.8.3 SELECT Commands for Videotape Material
Typing the appropriate key on the numeric keypad causes the video player to go into the corresponding mode of operation. Table 10-11 gives an explanation of each of the commands. The video player should start to respond immediately, however most of the operations take some time (10-20 seconds) to complete.

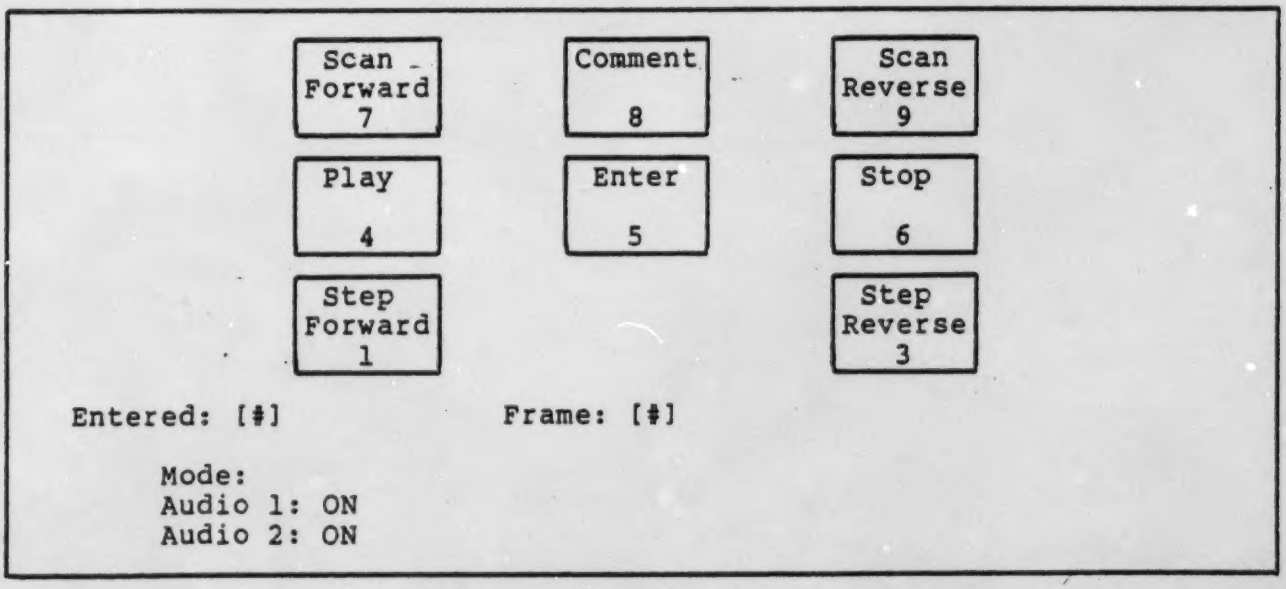
Table 10-11 SELECT Commands for Videotape

Command	Explanation
Comment	If you entered a text filename during initialization (See Section 10.8.1), comment allows you to enter a comment which is recorded in the text file on the disk. The comment can be used to explain the frame number entries you are making in the text file.
Enter	Enter places the frame number of the present location on the tape in a text file on the disk.
Fast forward	Places the videotape player in the fast forward mode of operation, which fast forwards the tape towards the end of the tape.
<I>	Typing "I" places the videotape player in rewind mode and quickly moves the tape back to frame 0. The frame number display is reset to 0.
Index	Displays the current frame number to the right of the word INDEX. This command is used to determine the location of a given place in a video sequence while it is playing. The index can be recorded on paper for later use in the BUILDER program.
Pause	If the video player is in the Play mode, the Pause command stops the video player while continuing to display the present frame. WARNING--It is hard on the videotape to leave the player in pause for extended time periods.
Play	Places the video player in the play mode where the video and audio sequences are played.

Table 10-11 (Cont.) SELECT Commands for Videotape

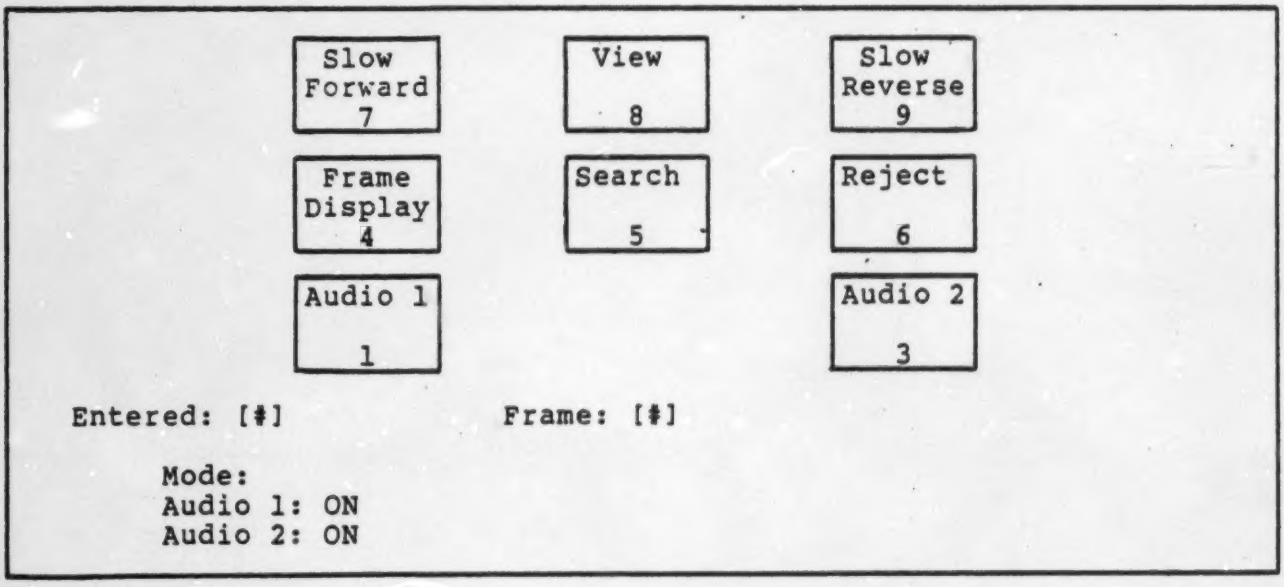
Command	Explanation
Quit	Exits you from the program. Quit does not affect the present mode of the video player. First stop the videotape by choosing Stop and then type "Q" for Quit.
Rewind	Places the video player in a fast rewind mode and moves the tape back toward the beginning.
Stop	Stops the motion of the videotape in the player. This command works from any of the other modes of operation.

10.8.4 SELECT and Videodisc Material
When SELECT is run with the videodisc player, the screen appears as follows:



Terak Screen Display for Videodisc Material

An alternate screen display is available which presents the remaining videodisc options. Type the 2 key on the numeric keypad to switch between the two displays.



Alternate Terak Screen Display for Videodisc Material

10.8.5 SELECT Commands for Videodisc Material
Typing the appropriate key on the numeric keypad will cause the video player to go into the corresponding mode of operation. Search and View require frame numbers; Slow (forward and reverse) requires a delay rate. Use the numeric keypad to enter the numbers required.

Table 10-12 gives an explanation of each of the commands. The videodisc player responds immediately to the commands after the disk is moved into the read position. When you begin using SELECT the disk is in the stationary position and the only functional options are Play, Audio 1 and Audio 2.

Table 10-12 SELECT Commands for Videodisc

Command	Explanation
Audio (1 and 2)	The video material can be accompanied by two audio tracks. Choosing Audio 1 or 2 allows you to turn the audio channel on if it is off and vice versa.
Comment	If you entered a text filename during initialization (See Section 10.8.1), comment allows you to enter a comment which is recorded in the text file on the disk. The comment can be used to explain the frame number entries you are making in the text file.

Table 10-12 (Cont.) SELECT Commands for Videodisc

Command	Explanation
Enter	Enter places the frame number of the present location on the disc in a text file on the disk.
Frame display	The frame numbers are superimposed on the T.V. picture. Choosing frame display again turns them off.
Play	Places the video player in the play mode with the video and both audio channels on.
Quit	This will terminate execution of SELECT. It should be noted, however, that this command does not affect the present mode of the video player. To exit SELECT, first Reject the videodisc (6 on the numeric keypad in the alternate display) and then terminate SELECT by typing "Q" for Quit.
Reject	Reject interrupts the player operation and returns the disc to the stationary position.
Search	Search is used to obtain rapid access to a desired frame. A query line will appear requesting the frame number. Enter the frame number using the numbers on the numeric keypad. The T.V. screen will go blank momentarily and then the frame will be displayed in freeze frame mode.
Scan (forward or reverse)	Places the videodisc player in the scan forward or reverse mode of operation which allows you to view the material rapidly in the forward or reverse direction to find a particular segment.
Slow (forward or reverse)	The slow motion mode is variable from 10 frames per second to stop. You are requested to enter a delay rate which is a number between 0.1 and 10 and represents the number of frames per second. Use the numeric keypad to enter the numbers and <DEL> (lower right corner of the numeric keypad) to enter the decimal point, if any.

Table 10-12 (Cont.) SELECT Commands for Videodisc

Command	Explanation
Step (forward or reverse)	Step forward or reverse allows you to view the video material one frame at a time in the forward or reverse direction. The next frame is displayed each time you choose this command. This command is useful for viewing a series of still frames and for choosing the exact frame to begin or end a video segment.
Stop	Stops the playing of the video material, resulting in a freeze frame.
View	View allows you to specify the beginning and end points of a video segment which is then played. This allows you to check and see if the numbers specified are correct. The first frame of the of the segment is requested. After you enter the frame number, SELECT will find the first frame and request the last frame number of the segment. After you enter the last frame, the specified segment will be played.

10.8.6 Errors in SELECT

1. There is no video player connected. Program terminated.

   If SELECT detects that no video player is connected, this message will appear and the program will terminate. Check the connections to the video player and, if you are viewing videotape, check that the video controller is on.

2. Unable to open SELECT.GRAF.

   SELECT.GRAF contains the graphics representing the numeric keypad. This file must be present for SELECT to run. A copy of SELECT.GRAF is included on the distribution disk.

3. Unable to read SELECT.GRAF.

   SELECT is unable to read the information in the file SELECT.GRAF. Either there is a bad block on the disk (ECP 2) or the file is corrupted. If the file is corrupted use the System Filer to transfer a new copy from the distribution disk to your disk.

4. Unable to open SELECT.PAGE.

   SELECT.PAGE contains the graphics representing the numeric keypad. This file must be present for SELECT to run. A copy of SELECT.PAGE is included on the distribution disk.

5. Unable to read SELECT.PAGE.

   SELECT cannot read the information in the file SELECT.PAGE. Either there is a bad block on the disk (ECP 2) or the file is corrupted. If the file is corrupted use the System Filer to transfer a new copy from the distribution disk to your disk.

6. Unable to open [filename].TEXT.

   SELECT is unable to create the comment file on the disk. Either there is no space on the disk or you already have 77 files on the disk. If you are on a single drive system, exit SELECT and use the System Filer to create some space on the disk. If you are on a double drive system, specify a file in the other drive.

7. Unable to execute command.

   SELECT is unable to execute the videotape command specified. Pause can only be executed from the Play mode.

7.6 DISPLAY

The frame display commands are used to display frames. Frames can contain: text, graphics, animations, graphics screen images, and audio-visual sequences. The remaining Display commands (Echo, Counter, Part, and Reply) display other specific materials.

DISPLAY: Text Graphics Echo Animation Foto Counter Part Reply Video

Table 7-4 The Display Commands

Command	Section	Explanation
Animation	7.6.4	to specify the name of a frame file and a display file for an animation sequence.
Counter	7.6.6	to display the student's score on the top line: both the right and wrong counts, one or the other, or neither.
Echo	7.6.3	to display within a line of text or by itself the last student answer or material saved in a memory location. Also used to display a line of text only.
Foto	7.6.5	to specify the name of a graphics that is an exact representation of the screen.
Graphics	7.6.2	to specify a graphics frame for display.
Part	7.6.7	to display part of the text or graphics screens. Both screens are divided into three horizontal sections. Any combination of these sections can be displayed.
Reply	7.6.8	to display a response to a student answer that is randomly selected from either the standard set or your set of right, wrong, or neutral replies.
Text	7.6.1	to specify a text frame for display.
Video	7.6.9	to display a video sequence, a video frame, or to play the sound only.

7.6.9 Video

Video is used to include material on either tape or disc. This material can be presented alone or together with computer-generated material. Use the Wait-Frame command, Section 7.13, to synchronize the presentation of video and computer-generated material.

With videodisc material, the sound channels may both be played, one or the other played, or the sound turned off. Videodisc frames can be displayed as still frames or in slow motion forward or backward.

Use the video selection program, SELECT, Chapter 10, Section 8, to view your video material and determine the frame numbers of the starting and stopping points for the sequences.

```
VIDEO: Audio Blank Display oFf Play On Reject Slow
```

Table 7-8 The Display-Video Commands

Command	Section	Explanation
Audio	7.6.9.1	to specify the audio channel to play with the video material, if other than both.
Blank	7.6.9.2	to turn off the video, playing the sound.
Display	7.6.9.3	to display a single frame.
oFf	7.6.9.4	to immediately turn off the video.
On	7.6.9.4	to immediately turn on the video.
* Play	7.6.9.5	to play a video sequence.
Reject	7.6.9.4	to reject the videodisc.
Slow	7.6.9.6	to play a videodisc sequence forward or backward in slow motion.

* Play is the only command applicable to videotape material.

7.6.9.1 Audio
There are two channels on the videodisc. Use audio to specify if other than both audio channels are played. The Play command (Section 7.6.9.5) always plays both audio channels.

```
AUDIO: audio1 audio2 both_oFf both_On
```

Type "1" to play audio channel 1, "2" for audio channel 2, "F" for both off, or "O" for both audio channels on.

The next three query lines are the same in Audio, Blank, and Play.

```
Starting frame:
```

Enter the videodisc frame number which begins the sequence.

```
Ending frame:
```

Enter the frame number, greater than the starting frame number, which ends the sequence.

```
VIDEO-LESSON:  Continue  Wait
```

Choose Continue to display computer-generated material at the same time a video or audio sequence is running. Synchronization is achieved with the Wait-Frame command (Section 7.13).

Choose Wait to have the presentation of computer-generated material stop until the video sequence is over.

These are the steps for playing a video sequence from frame 1000 to frame 5000 with audio channel 2 on. The presentation of the computer-generated material continues while the video sequence is playing.

Action	Command File Record
1. Select Display.	* Display
2. Specify Video.	Video
3. Select Audio.	Audio
4. Type 2.	2 ; audio2
5. Enter the starting frame number.	1000
6. Enter the ending frame number.	5000
7. Specify the lesson continues.	Continue

7.6.9.2 Blank
Blank allows you to play a video sequence with the video off. You specify which audio channels are played.

```
BLANK:  audio1 audio2 both_oFf both_On
```

The Blank promptlines are the same as in Audio (Section 7.6.9.1).

These are the steps for specifying an audio sequence from frame 1000 to 5000 with audio channel 1 on only.

Action	Command File Record
1. Select Display.	* Display
2. Specify Video.	Video
3. Select Blank.	Blank
4. Type 1.	1 ; audio1
5. Enter the starting frame number.	1000
6. Enter the ending frame number.	5000
7. Specify the lesson continues.	Continue

7.6.9.3 Display
Choose Display to display one frame on the videodisc.

Frame number:

Enter a number between 1 and the largest frame number on the videodisc.

These are the steps for displaying frame 3000.

Action	Command File Record
1. Select Display.	* Display
2. Specify Video.	Video
3. Select Display.	Display
4. Enter frame number 3000.	3000

7.6.9.4 On, oFf and Reject
There are no promptlines specific to On, oFf or Reject. The command sequence is completed as soon as any of these commands is chosen.

Use the Reject command only if the videodisc must be changed during the lesson. The videodisc is automatically rejected when the student stops the lesson.

These are the steps for turning off the video. The video remains off until a Display-Video-On, Play, or Display is specified.

Action	Command File Record
1. Select Display.	* Display
2. Specify Video.	Video
3. Choose oFf.	F ; off

These are the steps for turning on the video.

Action	Command File Record
1. Select Display.	* Display
2. Specify Video.	Video
3. Choose On.	On

These are the steps for rejecting the videodisc.

Action	Command File Record
1. Select Display.	* Display
2. Specify Video.	Video
3. Choose Reject.	Reject

7.6.9.5 Play
Play is the only command used for both videodisc and videotape. With a videodisc sequence both audio channels are automatically played.

For videotape sequences, enter the frame numbers as displayed by SELECT (Chapter 10, Section 8). INTERP (Chapter 9) converts the frame numbers to the SMPTE time code.

The Play promptlines are the same as in Audio (Section 7.6.9.1).

In this example a video sequence is played from frame 1000 to 5000.

Action	Command File Record
1. Select Display.	* Display
2. Specify Video.	Video
3. Select Play.	Play
4. Enter the starting frame number.	1000
5. Enter the ending frame number.	5000
6. Specify the lesson waits.	Wait

7.6.9.6 Slow
The Slow command allows you to play a videodisc sequence in slow motion forward or backward. To play a sequence slow motion backward specify an ending frame number less than the starting frame number.

```
Frames per second (0.1 to 10):
```

Enter the number of frames displayed per second, to the nearest tenth of a second. Next you are asked for the frame number of the first and last frame in the slow motion sequence.

These are the steps for specifying a slow motion sequence from frame 1500 backwards to 1000 with 2 frames per second displayed.

Action	Command File Record
1. Select Display.	* Display
2. Specify Video.	Video
3. Select Slow.	Slow
4. Specify 2 frames per second.	2
5. Enter the starting frame number.	1500
6. Enter the ending frame number.	1000

APPENDIX C

Presentations and Workshops by R. Brandt and B. Knapp

PRESENTATIONS

"Development of the Video-computer Courseware Implementation System," National Educational Computing Conference, Kansas City, Missouri, June 1982.

"Demonstration of a Videodisc System for the Classroom," Association for Computing Machinery Annual Conference, Los Angeles, California, November 11, 1981.

"Research and Application of Videodiscs," National Educational Computing Conference, North Texas State University, Denton, Texas, June 1981.

"Video-computer Courseware Implementation System," National Educational Computing Conference, North Texas State University, Denton, Texas, June 1981.

"Video-computer Courseware Implementation System," University of Maryland, Maryland, May 1981.

"Video-computer Courseware Implementation System", National Science Foundation, Washington, D.C. May 1981.

"Interactive Videodisc: The Idea Becomes a Reality," Association for the Development of Computer-Based Instructional Systems - 1981 Conference, March 1981, Atlanta, Georgia.

"Video-computer Courseware Implementation System," Naval Post Graduate School, Monterey, California, February 1981.

"Video Computer Authoring System," CERL, University of Illinois, Champaign-Urbana, Illinois, December 1980.

"Video Computer Authoring System," U. S. Naval Academy, Annapolis, Maryland, December 1980.

"Lesson Design and Production," North Carolina Central University, Durham, North Carolina, December 1980.

"Demonstration of CAL Materials and an Authoring System," Comprehensive Assistance to Undergraduate Science Education (CAUSE) Project Directors' Meeting, Atlanta, Georgia, October 1980.

"University of Utah's Computer Authoring System," National Symposium on Videodisc Programming, University of Nebraska, Lincoln, Nebraska 1980.

"Video Computer Learning Project," Interactive Videodisc Applications Conference sponsored by the American Video Institute, Columbia University, New York, New York, May 1980.

WORKSHOPS

"Video-computer Courseware Implementation System," to ACTO at Ft. Eustis, Virginia for the United States Army, May 18 - 22, 1981.

"Video Computer Authoring System," Amarillo College, Amarillo, Texas, January 1981.

"Video Computer Authoring System," The University of Utah, Salt Lake City, Utah, November 1980.

"Video Computer Authoring System," Adams State College, Alamosa, Colorado, May, 1978.

APPENDIX D

Publications by R. Brandt and B. Knapp on Video in Education

"Courseware Transportability Issues", ADCIS 82: Computer Literacy, Intelligent CAI, June, 1982.

Video-computer Courseware Implementation System User's Manual, University of Utah, 1981, 414 pages.

"Interactive Videodisc Authoring Concepts," The Third Annual Conference on Interactive Video Systems sponsored by the Society for Applied Learning Technology, Los Angeles, California, August, 1981.

"Interactive Videodisc Authoring Concepts," Chapter 4, Videodisc/Microcomputer Courseware Design, Michael L. DeBloois, editor, Education Technology Publications.

"The University of Utah Video Computer Authoring System." Symposium on Learning Technology for the 80's sponsored by the The Society for Applied Learning Technology, Orlando, Florida, February, 1981. pp 18-23.

"The Video Computer Learning Project," Pipeline, Fall 1980, p. 12.

"Video Computer Authoring System," Pipeline, Fall 1980, 13.

Video Computer Authoring System User's Guide, University of Utah, 1979, 250 pages.